What is claimed is:

1   1. A method for changing a scanning period used in a liquid crystal
2 display, comprising:
3   determining a reference clock period from a first number of original clock
4 periods;
5   determining said scanning period from a second number of said reference
6 clock periods; and
7   changing said scanning period by at least one reference clock period.

1   2. A liquid crystal display controller for changing a scanning period
2 used in a liquid crystal display, comprising:
3   a reference clock generator for generating a reference clock period from a
4 first number of original clock periods;
5   a timing generator coupled to said reference clock generator for generating
6 a line pulse synchronized with a scanning period, said scanning period having a second
7 number of said reference clock periods; and
8   a control register having a third number of said reference clock periods for
9 changing said scanning period, wherein said third number is at least one original clock
10 period different from said second number.

1   3. A liquid crystal display controller for displaying a desired image on
2 a liquid crystal panel comprising a plurality of scan lines, the liquid crystal display
3 controller comprising:
4   a control register for storing operating parameters, comprising a first
5 number of reference clock periods in a scanning period and a second number of scan lines
6 in a frame period;
7   a reference clock generator for generating reference clocks for a timing
8 generator;
9   said timing generator for generating line pulses synchronized with one
10 scanning period and frame pulses synchronized with one frame period.

1   4. The liquid crystal display controller of claim 3 wherein said
2 operating parameters further comprise a division ratio and wherein said reference clock
3 from said reference generator is generated from an original clock using said division ratio.

1   5.   The liquid crystal display controller of claim 4 wherein said

2 division ratio is one.

1   6.   The liquid crystal display controller of claim 3 further comprising

2 an external computer coupled with said control register for determining said first number

3 given said second number and a frame frequency.

1   7.   The liquid crystal display controller of claim 6, wherein in

2 conjunction with said determining said first number, a division ratio is also determined.

1   8.   The liquid crystal display controller of claim 7, wherein said

2 determining said division ratio and said first number given said second number and said

3 frame frequency is determined using a look-up table.

1   9.   A liquid crystal display controller for displaying a desired image

2 on a liquid crystal panel , the controller comprising:

3   a display memory for storing display data, including gradation data;

4   a control register for storing operating parameters, comprising a first

5 number of reference clock periods in a scanning period and a second number of active

6 lines in a frame period;

7   a reference clock generator for generating reference clocks for a timing

8 generator;

9   the timing generator for generating line pulses synchronized with one

10 scanning period, frame pulses synchronized with one frame period, and a gradation signal

11 indicating an effective period;

12   a scanning line driver for outputting selected and non-selected voltages as

13 scanning signals to the liquid crystal panel, wherein the selected voltage in applied only

14 during the effective period;

15   a gradation processor for reading gradation display data for a selected line

16 from the display memory to convert it into a pulse width modulated (PWM) signal; and

17   a data line driver for converting the PWM signal into a data signal for

18 output to the liquid crystal panel.

1   10.   The liquid crystal display controller according to claim 9, wherein
2   said first number of reference clock periods is equal to or larger than (a number . of
3   gradation steps to be displayed minus 1).

1   11.   The liquid crystal display controller according to claim 9, wherein
2   the data signal has the same voltage level at the end of one scanning period as at the
3   beginning of the next scanning period.

1   12.   The liquid crystal display controller according to claim 9,
2   wherein, for the data signal, the timing of voltage level change differs from even frame to
3   odd frame.

1   13.   The liquid crystal display controller according to claim 9, wherein,
2   for the data signal, the timing of voltage level change differs from even data line to odd
3   data line, including when the same gradation is displayed.

1   14.   The liquid crystal display controller according to claim 9, wherein,
2   when the data signal voltage level is for black or white, the voltage level changes at least
3   once per scan line.

1   15.   A cellular phone system, comprising:
2   a liquid crystal panel for displaying a partial screen display, comprising a
3   first predetermined number of active lines, and a full screen display, comprising a second
4   predetermined number of active lines;
5   a liquid crystal display controller for controlling at least a display of an
6   active line period on said liquid crystal panel; and
7   a processor for determining a first active line period for said partial display
8   and a second active line period for said full display, such that a first frame frequency for
9   said partial display is approximately equal to a second frame frequency for said full
10 screen display.

1   16.   The cellular phone system of claim 15 wherein said second frame
2   frequency is equal to an inverse of a product of said second predetermined number of
3   active lines multiplied by said second active line period.

1   17.   The cellular phone system of claim 15 wherein said first frame

2 frequency is equal to an inverse of a product of said first predetermined number of active

3 lines multiplied by said first active line period, said first active line period comprising a

4 number of reference clock periods, wherein a reference clock period comprises a division

5 ratio multiplied by an original clock period.

1   18.   A cellular phone system, comprising:

2   a liquid crystal panel for displaying a full screen display, comprising a

3 predetermined number of active lines;

4   a liquid crystal display controller for controlling at least a display of an

5 active line period on said liquid crystal panel, wherein said active line period comprises a

6 number of reference clock periods, wherein each reference clock period comprises a

7 division ratio multiplied by an original clock period; and

8   a processor for determining a first active line period for a contrast oriented

9 mode having a predetermined frame frequency and a second active line period for a

10 stand-by mode having a lower predetermined frequency.

1   19.   A computer readable medium containing a data structure,

2 comprising a table for determining a scanning period given a frame frequency and a

3 number of active lines, comprising, a first entry for said number of active lines; a second

4 entry for a division ratio number associated with said scanning period; a third entry for a

5 number of reference clock periods for said scanning period, and a forth entry having a

6 calculated frame frequency dependent on said scanning period and substantially equal to

7 said given frame frequency.

1   20.   A method for maintaining a frame frequency at a substantially

2 constant value for a liquid crystal display, having different numbers of active scan lines,

3 said method comprising:

4   selecting a first number of said different numbers of scan lines, wherein

5 each scan line period for said first number is based on a second number of reference clock

6 periods; and

7   determining said second number such that the inverse of a product is

8 substantially equal to said frame frequency, wherein said product comprises said first

9 number multiplied by said second number multiplied by a reference clock period.

1   21.   The method of claim 20 wherein said reference clock period is

2 division ratio multiplied by an original clock period.

1   22.   The method of claim 21 wherein said division ratio is 1.

1   23.   The method of claim 21 wherein said division ratio is a power of 2.

1   24.   A method for changing a frame frequency of a liquid crystal

2 display having a predetermined number of scan lines, comprising:

3   determining a scan line period for said frame frequency, wherein said

4 frame frequency equals an inverse of a product, said product comprising said scan line

5 period times said predetermined number of scan lines;

6   selecting a new frame frequency; and

7   determining a new scan line period for said new frame frequency, wherein

8 said new frame frequency equals an inverse of a new product, said new product

9 comprising said new scan line period times said predetermined number of scan lines.

1   25.   A method for providing substantially linear effective voltage

2 characteristics for displaying a predetermined first number of graduation steps on a liquid

3 crystal display, said liquid crystal display using a scanning period based on a second

4 number of reference clocks, comprising:

5   selecting said second number such that said second number is greater than

6 or equal to said predetermined first number minus one;

7   setting an effective period from said first reference clock period to said

8 predetermined first number minus one reference clock period; and

9   displaying graduation step data only in said effective period.

1   26.   The method of claim 25 wherein said reference clock periods from

2 said predetermined first number to said second number is an ineffective period, and an

3 unselected voltage is sent to said liquid crystal display during said ineffective period.

1   27.   The method of claim 25 wherein for a selected graduation step, a
2   PWM signal associated with said selected graduation step is inverted every other
3   scanning period.

1   28.   The method of claim 25 wherein for a selected graduation step, a
2   PWM signal associated with said selected graduation step begins with an ON voltage in
3   one frame and an OFF voltage in a subsequent frame.

1   29.   The method of claim 25 wherein for a selected graduation step, a
2   PWM signal change associated with said selected graduation step is set for one scan line
3   and delayed by at least one reference clock period for a subsequent scan line.

1   30.   The method of claim 25 wherein for a selected graduation step of
2   black, a PWM signal associated with said selected graduation step is changed at least
3   once per scan line.

1   31.   A method for conserving power in a cellular phone display by
2   switching from a full screen display to a partial screen display while maintaining a
3   substantially constant frame frequency, said method comprising:
4   displaying said full screen display, comprising a first frequency;
5   determining a scanning period for said partial display comprising a
6   predetermined number of active lines such that said second frequency is substantially
7   equal to said first frequency; and
8   upon request, switching said full screen display to said partial screen
9   display having said scanning period.

1   32.   The method of claim 31 wherein said determining said scanning
2   period includes calculating a number of reference clock periods in a ratio of said
3   predetermined number of active lines divided by said second frequency.

1   33.   A method for providing a good contrast display mode having a first
2   frame frequency and a power savings display mode having a second frame frequency in a
3   cellular phone system, wherein said first frame frequency is higher than said second
4   frame frequency, said method comprising:

5   determining a first scan line period for said good contrast display mode

6   based on said first frame frequency and a predetermined number of scan lines;

7   determining a second scan line period for said power savings display mode

8   based on said second frame frequency and said predetermined number of scan lines; and

9   displaying a full screen display on a liquid crystal panel, comprising said

10   predetermined number of scan lines, using either said first scan line period or said second

11   scan line period depending upon a selection of said good contrast display mode or said

12   power savings display mode.

1   34.   A computer program product stored on a computer readable

2   medium for changing a scanning period used in a liquid crystal display, said computer

3   program product comprising:

4   code for determining a reference clock period from a first number of

5   original clock periods;

6   code for determining said scanning period from a second number of said

7   reference clock periods; and

8   code for changing said scanning period by at least one reference clock

9   period.

1   35.   A computer program product stored on a computer readable

2   medium for maintaining a frame frequency at a substantially constant value for a liquid

3   crystal display, having different numbers of active scan lines, said computer program

4   product comprising:

5   code for selecting a first number of said different numbers of scan lines,

6   wherein each scan line period for said first number is based on a second number of

7   reference clock periods; and

8   code for determining said second number such that the inverse of a product

9   is substantially equal to said frame frequency, wherein said product comprises said first

10   number multiplied by said second number multiplied by a reference clock period.